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ON THE EXISTENCE
OF A
SYSTEM OF ANASTOMOSING ARTERIES BETWEEN AND CONNECTING THE VISCERAL AND PARIETAL BRANCHES OF THE ABDOMINAL AORTA.

By WILLIAM TURNER, M.B. (Lond.), F.R.C.S.E.
Senior Demonstrator of Anatomy, University of Edinburgh.

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ON THE EXISTENCE

OF A

SYSTEM OF ANASTOMOSING ARTERIES,

ETC. ETC.

THE question of the existence or non-existence of inosculations between the branches of the abdominal aorta which supply the viscera of the abdomen and the branches which are distributed to the parietes of that cavity, has from time to time excited the attention not only of the anatomist, but of the practitioner of medicine. In several of our standard anatomical works it has, indeed, been recognised that some of the abdominal visceral arteries—e.g., the renal, supra-renal, and spermatic, give off, previous to entering their respective viscera, small branches to the fat and areolar tissue, with which their organs are more or less completely surrounded.*

Of the anatomical writers in this country, Harrison appears to have been the one who has most distinctly announced this to be the case. Not only does he state (p. 59) that the renal artery, before entering the kidney, gives off small branches to the surrounding cellular membrane and muscles, but he even goes further, and on page 67 says that the middle sacral artery sends branches to the rectum, and on page 37 he points out that the hepatic artery communicates with the phrenic, intercostal, lumbar, epigastric, and internal mammary arteries.

Of late years, however, some writers have exhibited a tendency to ignore the existence of any such anastomoses between the visceral and parietal branches of the abdominal aorta, and to speak of them as altogether distinct systems; as communicating with each other only through the common trunk from which they both spring.†

This assumption of the absence of any direct communication between these two sets of vessels has been employed by some physicians as a powerful argument against the utility of local bloodletting in the treatment of inflammations of the abdominal viscera.*

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* Harrison : Surgical Anatomy of the Arteries. Cruveilhier : English translation, p. 681. Quain and Sharpey: ed. 1848, p. 561.

† See especially a paper by Dr. Struthers in the Edinburgh Monthly Journal of Medical Science, April, 1853.

For some time back I had been led to believe, from many observations made in the dissecting-room, that the visceral and parietal branches of the abdominal aorta communicated much more freely with each other than is commonly supposed and taught by anatomists. With the object, however, of testing my observations, and of coming to more precise conclusions on this subject than was possible by an ordinary dissecting-room examination, I made during the summer of last year and the present one a series of special injections, and have succeeded in demonstrating the existence of a very complete series of anastomosing arteries between the visceral and parietal branches of the abdominal aorta. In the course of this examination I have employed the bodies of an adult male, an adult female, and those of two children. The method I have pursued has been to open the abdomen along the middle line, and then with as little disturbance of the parts as possible to insert an injecting pipe into a visceral artery, and then inject viscera-wards. The course taken by the fluid employed and the parts to which it proceeded, were then carefully noted. The injection used was a stiff gelatine, sometimes coloured red, sometimes yellow. The latter colour was, however, preferred.

The arteries which were especially selected for observation were the two renal and two spermatic arteries, the colic branches of the inferior mesenteric, the ileo-colic and right colic branches of the superior mesenteric and the hepatic. To record in detail the results of each injection would probably be too tedious, and not, indeed, so satisfactory as a general summary of the results obtained, although, in one or two cases, it may perhaps be advisable to speak more particularly of the course which the injection took and the vessels which were filled by it.

By these injections I have succeeded in demonstrating the existence behind the peritoneum of a well-marked vascular plexus, to which I propose to give the name of sub-peritoneal arterial plexus. This plexus lies behind the peritoneum, not only in the lumbar and iliac regions, but extends upwards as far as the diaphragm, and downwards into the cavity of the pelvis. It consists of fine elongated arteries, which freely anastomose with each other, so as to form a wide-meshed and somewhat irregular network. It communicates on the one hand with the arteries of the abdominal viscera, and on the other with the arteries of the different parts of the abdominal wall. Through it the visceral and parietal arteries are brought into anatomical communication with each other, so that the vessels in the wall can be injected from many of the visceral branches. The anastomoses, through the intervention of this plexus, are especially well-marked in, but not exclusively confined to, those vessels which supply viscera situated altogether behind, or only partially invested by the peritoneum.

The plexus communicated freely with the renal and supra-renal arteries, with the arteries of the pancreas, with those of the duodenum, cæcum, ascending and descending portions of the colon. It extended forwards also between the layers of the transverse meso-colon and anastomosed with the branches of the middle colic artery. It passed downwards between the folds of the mesentery, reaching as far as the coils of the small intestine, and communicated with the branches of the superior mesenteric artery, which supply that portion of the alimentary canal. It could also be traced upwards between the folds of the gastro-splenic omentum to the hilum of the spleen, where it anastomosed with the splenic artery. In the hepatic region also, it was seen passing between the folds of the falciform or suspensory ligament of the liver, as well as, and even more strongly marked, along the line of reflection of the coronary and lateral ligaments. In these localities it could be readily injected from the hepatic artery, and through it that vessel inosculated with the diaphragmatic arteries.

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* Dr. Bennett: Clinical Lectures, 1859, p. 280.

In the cavity of the pelvis also, the plexus was situated between the layers of the meso-rectum and anastomosed with the hæmorrhoïdal arteries. It extended in the female between the folds of the broad ligament to the uterus, ovaries, and Fallopian tubes, and it communicated also with the vesical arteries.

But this plexus does not appear to be confined in its office to that of an inosculating medium between the visceral and parietal branches of the abdominal aorta. The arteries of which it is composed evidently perform the function of nutrient arteries for many of the structures at the back of the abdomen, more especially the sub-peritoneal fat and areolar connective-tissue, which exist in such abundance in this locality. In addition, branches could be seen passing from it to the chains of lymphatic glands, which lie along the track of the great bloodvessels, and even to the coats of the great arteries and veins themselves, with the vasa vasorum of which they appeared to inosculate.

Since my attention has been directed to this plexus through the various injections I have made, I have more than once in the ordinary post-mortem examination of bodies, where the small abdominal vessels have been more than usually engorged with blood, traced its principal ramifications without the aid of any other than this their natural injecting material.

Such being a general description of the arrangement and connexions of the sub-peritoneal arterial plexus, it may be well, perhaps, in the next place to refer somewhat more minutely to its disposition in certain special localities. If a pipe be put into one or other of the renal arteries, and the injection forced into the organ, it will be found that not only is the kidney injected, but that the fluid employed finds its way into that portion of the sub-peritoneal arterial plexus which is situated more immediately in the fatty capsule in which the kidney is embedded. If the pressure be kept up, the injection gradually extends itself into the parts of the plexus situated at a greater distance, until in the course of time the whole is filled. If the injection has been made on the right side, many fine arteries may be easily traced from this plexus to the lower end of the ileum, cæcum, and ascending colon, with the arteries of which they communicate. If on the left side, to the descending and sigmoïd parts of the colon, the vessels of which they join. If now the abdominal wall be cut into, it will be seen that the parietal arteries are more or less perfectly filled, the lumbar, ileo-lumbar, circumflex ilii, lower intercostal and epigastric arteries all containing injection, which has evidently passed into them, not by the way of the trunks from which they arise, but through the inosculations between those of their branches which supply the inner aspect of the abdominal wall and the sub-peritoneal arterial plexus. By removing on one or other side the section of the colon lying anterior to the kidney, and by carefully dissecting down through the fatty capsule, the course which the injection has taken in its passage from the renal artery to the sub-peritoneal arterial plexus may be seen.

Various anatomists have taught that the renal artery gives off before entering the kidney small branches which pass to the fatty capsule surrounding the organ, and undoubtedly these are, in part, the channels along which the injection flows. But they are not the only, and apparently not the most important ones; for in all the cases examined I have traced small arteries passing out of the substance of the kidney, piercing its fibrous coat, and joining the arterial plexus in the fatty capsule. Occasionally these arteries pierced the fibrous coat of the kidney at various points on its surface without following any definite plan, but at other times the arrangement was of a more regular nature. In one case three well-marked arteries pierced the fibrous coat on the posterior surface of the organ—one about the centre of this surface, the others close to its extremities. They all passed outwards into the surrounding fat and areolar tissue. Those from the extremities inclined towards each other, joined, and formed a well-marked arterial arch, which again communicated with the artery which pierced the middle of the posterior surface of the gland. From this arch branches passed in various directions, so as to connect this with the adjacent parts of the sub-peritoneal arterial plexus.

In another case, not only were arteries found piercing the fibrous coat on the surfaces of the kidney, but, in addition, one very well-marked artery came through about the centre of the posterior convex margin. It immediately divided into several branches, some of which passed towards the surfaces, others towards the extremities of the organ, to anastomose with the arteries which had pierced the fibrous coat in those localities.

These perforating vessels, which arise from the renal artery whilst in the substance of the kidney, and which then pierce its fibrous coat, would appear not only to serve the highly important office of connecting the renal trunk with the arteries of the abdominal parietes, but, in addition, they doubtless fulfil a functional duty of some moment. Physiologists have been in the habit of considering that the entire force of the current of blood flowing along the renal artery, is expended in the propulsion of the blood through the complex vascular arrangements within the substance of the kidney itself. But the existence of these arteries perforating the fibrous coat, shows that such is not altogether the case. For some portion, small though it may be, of this force, is necessarily employed in propelling the blood along them into the surrounding sub-peritoneal arterial plexus. It is possible that this subsidiary outlet for the blood from an organ possessing so tense a fibrous coat, and so complicated an internal vascular structure as the kidney, may, at times, when, through engorgement of the venous system, the exit of the blood along its principal canal, the renal vein, is impeded, serve as a sort of safety-valve, and diminish the tendency to extravasation and effusion into its substance.

I have already stated, that through the vascular arrangements just described an injection may be forced from the renal arteries into those portions of the large intestine which lie in front of the kidneys. Other experiments which I have made show that an injection can travel in exactly the opposite direction from the intestine to the kidney. Thus I have placed a pipe in the ileo-colic artery, and filled the arteries of the lower end of the ileum, cæcum, and ascending colon, the injection has then passed into the sub-peritoneal arterial plexus lying behind the gut, with which these intestinal vessels communicate, and from this into the arteries which perforate the fibrous coat of the right kidney. Exactly corresponding results were obtained on the left side by injecting the left colic branch of the inferior mesenteric artery. In one case, in which I injected the renal artery yellow, and the colic branch on the same side red, I found the sub-peritoneal arterial plexus, between the kidney and intestine, partly containing the yellow and partly the red injection. In addition, in these cases, the injection had also passed into the vessels of the abdominal walls.

Very interesting and instructive results have also been obtained by injecting the spermatic arteries. Not only did the injection pass along these vessels into the substance of the testicles, but it was found that each artery, as it coursed down the lumbar and iliac regions, gave off numerous small branches, which communicated with the sub-peritoneal arterial plexus in the immediate vicinity of the spermatic trunks, and into which the injection proceeded. Further down, small branches were seen passing from each spermatic along the vas deferens into the pelvis as far as the bladder. Each artery also gave off, whilst in the inguinal canal, small vessels which communicated with the epigastric artery. In its course down the cord, the spermatic artery gave origin to many small twigs which proceeded to the coverings of the cord, and lower down in the scrotum branches proceeded from it to the parietal layer of the tunica vaginalis, in which they formed a very well-marked arterial network. These last-named branches assisted in the supply of blood to the various scrotal textures, and inosculated with the perineal and other cutaneous arteries sent to the region of the scrotum.

From the injections, the general results of which I have recorded above, the following conclusions may be drawn—

1st. That in the sub-peritoneal fat and areolar tissue a system of anastomosing arteries exists of greater extent and importance than has been hitherto generally recognised.

2nd. That there is a much greater amount of communication between the different branches of the abdominal aorta than is commonly supposed.

3rd. That not only is it possible to inject the arteries of the abdominal wall from those of the viscera, but that to some extent the bloodvessels of one viscus may be injected from those of another, and this not through the main trunk from which they both proceed, but through their mutual communications with an intermediate set of anastomosing arteries.

4th. Into the question of the efficacy or inefficacy of local bloodlettings in inflammations of the abdominal viscera it is not my intention to enter; but this may with certainty be said, that so much of the argument against its efficiency, as is based upon a supposed want of communication between the bloodvessels of the viscera and those of the wall, rests upon an assumption, and is not supported by careful experiment and observation.

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